MISCELLANEOUS PAPER NO. 6-761

SONISCOPE INVESTIGATION OF ELMENDORF AFB HOSPITAL ANCHORAGE, ALASKA

by

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December 1965

Sponsored by

U. S. Army Engineer Division
North Pacific

Conducted by

U. S. Army Engineer Waterways Experiment Station
CORPS OF ENGINEERS
Vicksburg, Mississippi

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FOREWORD

The soniscope investigation of concrete at Elmendorf AFB Hospital was authorized by a series of telephone calls between Mr. Harold Stuart, U. S. Army Engineer Division, North Pacific (NPD), Mr. R. E. Holmes, NPD, Mr. W. M. Knopp, U. S. Army Engineer District, Alaska, and Mr. T. B. Kennedy and Mr. Bryant Mather, Concrete Division, U. S. Army Engineer Waterways Experiment Station (WES) on 21, 25, and 26 August 1964, and confirmed by letter from the Division Engineer, NPD, dated 27 August 1964. The investigation was conducted during the period 28 August-16 September 1964 by Messrs. H. T. Thornton, Jr., and J. K. Allgood, Jr., WES, with the assistance of Mr. W. O. Thompson, Project Engineer, Alaska District, and Mr. Rodger Frank, Fort Worth District.

This report was prepared by Mr. Thornton under the supervision of Messrs. T. B. Kennedy, B. Mather, and E. E. McCoy, Jr., all of the Concrete Division, WES.

Directors of the WES during the conduct of this investigation and the preparation and publication of this report were Col. Alex G. Sutton, Jr., CE, and Col. John R. Oswalt, Jr., CE. Technical Director was Mr. J. B. Tiffany.

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SUMMARY

The hospital building at Elmendorf AFB, Anchorage, Alaska, was damaged by the earthquake of 27 March 1964. Developments occurred during the progress of work designed to repair the damaged concrete which led to a request for a soniscope investigation. The U. S. Army Engineer Waterways Experiment Station (WES) furnished a soniscope crew to make velocity measurements on concrete of suspected inferior quality in areas designated as most critical from a structural standpoint.

On the hospital building proper, 644 sonic velocity measurements were made. The measurements were made through various walls, columns, and beams to determine the representative velocity of the concrete or to find any cracked, shattered, or otherwise inferior concrete present at points where measurements were taken. Using appropriate combinations of the same points, diagonal measurements were also taken through the concrete to locate inferior concrete, particularly horizontal cracking, not detected by the straight-through measurements. In addition to locating inferior concrete, the pulse velocity measurements provided a good indication of the effectiveness of repair by epoxy grouting. To demonstrate this fact, one wall, used as a test panel, was marked with an array of points at which readings were taken before and after grouting with epoxy. Also in this connection, fifteen readings were taken on three 4-in.-diameter, epoxy-repaired cores, and two readings were taken on two 4-in.-diameter, undamaged cores, later broken in compression. Tensile-splitting tests were performed on 2-in.-diameter, epoxy-repaired cores.

Representative velocities of good concrete ranged between 13,000 and 15,000 fps. Some low velocities were exhibited in all sections tested, but low velocities were far more prevalent in ungrouted sections. Very significant increases in ultrasonic pulse velocities were obtained where both faces of an area of concrete were sealed and the section pumped to refusal with epoxy grout progressing from low to higher elevations.

Results of tests indicate that: the compressive strength of concrete in the hospital building probably ranges between [illegible]000 and 5000 psi; the epoxy-repaired concrete has a tensile-splitting strength as high as the original concrete; there are areas within the structure where epoxy repair is not complete and further penetration may not be possible unless the area is sealed and pumped from both sides.

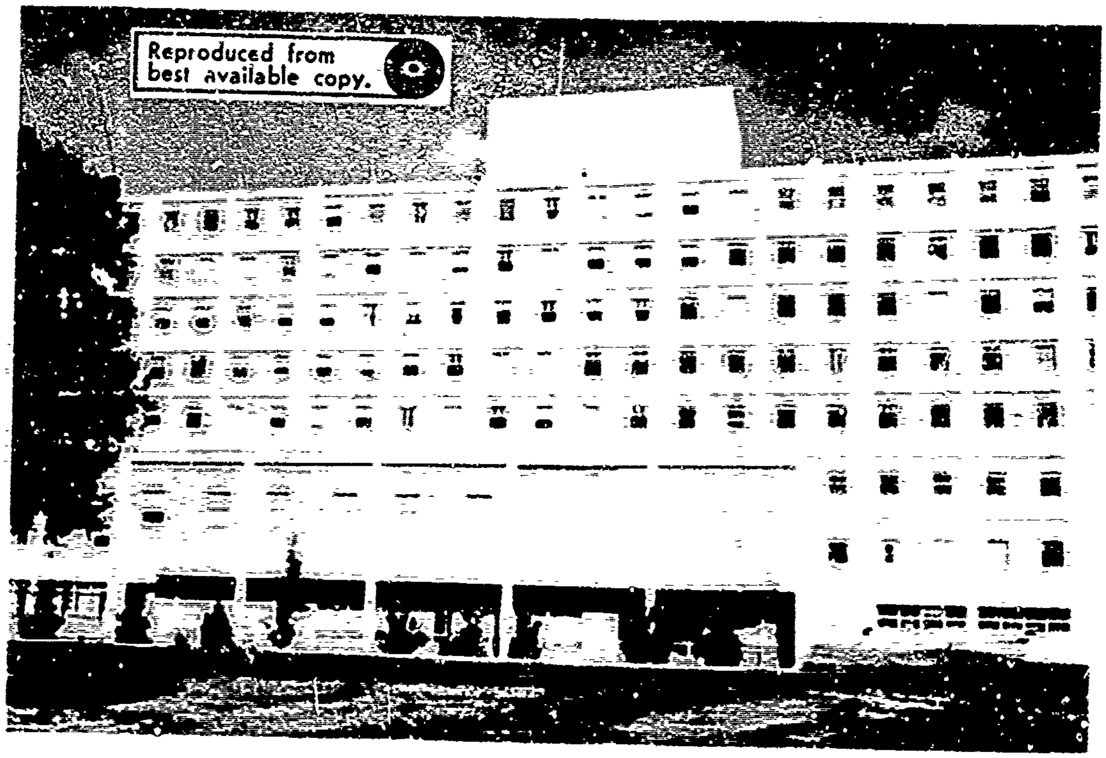

Fig. 1. South side of Elmendorf AFB Hospital

SONISCOPE INVESTIGATION OF ELMENDORF AFB HOSPITAL ANCHORAGE, ALASKA

PART I: INTRODUCTION

The Problem

1. The hospital building at Elmendorf AFB, Anchorage, Alaska, was one of the many structures damaged by the earthquake which occurred on 27 March 1964 (fig. 1). During the progress of work designed to repair the concrete by grouting with epoxy resin, it became apparent that the work was not completely successful. Complete filling could be obtained in the fine cracks, but the wider cracks were not always completely filled. Cores drilled from cracked areas showed compressive strengths ranging from 100 to 5000 psi. These developments led to a request for a soniscope investigation. It was thought that a well-planned series of pulse velocity readings would permit an intelligent estimate of the condition of the structure and of the success of the grouting operations which were in progress.

Purpose and Scope of Study

2. The U. S. Army Engineer Waterways Experiment Station (WES) furnished a soniscope and crew to make velocity measurements on concrete of suspected inferior quality in the hospital to locate any concrete damaged by cracking or shattering that might not be evident from a visual inspection and to obtain an indication of the success of repair by epoxy grouting.

3. The investigation was concentrated in areas designated as most critical from a structural standpoint, namely, main shear walls, columns, beams, and column-beam connections. On the hospital building proper, 644 readings were taken. Fifteen readings were taken on three 4-in.-diameter, epoxy-repaired cores, and two readings were taken on two 4-in.-diameter cores later broken in compression. One wall, used as a test panel, was marked with an array of check points at which readings

were taken before and after grouting. Three 4-in.-diameter cores were also tested to determine what effect epoxy repair had on ultrasonic pulse velocity in concrete. Tensile-splitting tests were performed on 2-in.-diameter, epoxy-repaired cores to compare the strength of the epoxy bond in cracked concrete with that of the undamaged concrete.

PART II: TEST EQUIPMENT AND PROCEDURES

Equipment

4. The soniscope equipment used was similar to that described in Corps of Engineers test method CRD-C 51-57.[1*] The soniscope is an instrument that transmits pulses of ultrasonic waves through a material, and electronically measures the time of travel from the transmitter to a receiver while each is held against the surface of the material a known distance apart. Knowing the time of travel and the path length, the velocities through the material can be computed by using the following formula:[1]

$$\text{Pulse velocity, fps} = \frac{\text{Path length, ft}}{\text{Effective time, sec}}$$

The pulse velocity provides an index of the condition or quality of the concrete through which the readings are taken.

Procedures

5. The procedure during the major part of the investigation was to take velocity measurements straight through various walls, columns, and beams to determine the representative velocity of the concrete or find any cracked, shattered, or otherwise inferior concrete present at points where measurements were taken. Using appropriate combinations of the same points used for the straight-through measurements, diagonal readings were also taken through the concrete to locate inferior areas, particularly horizontal cracking, not detected by straight-through readings. If the signal must cross any horizontal or vertical cracking, a lower velocity is indicated. By comparing velocities obtained through damaged and repaired concrete with velocities representing undamaged concrete, an indication of the condition of the damaged or repaired concrete can be obtained.

* Raised numbers refer to similarly numbered items in the Selected Bibliography following the text of this report.

PART III: TESTS AND RESULTS

Soniscope Tests and Results

6. Results of the soniscope tests are given in tables 1-36. These tables include station numbers, station references, path lengths, velocities, remarks, and in some instances station location diagrams.

R wall

7. Sixty-five readings were taken on the R wall (figs. 2 and 3). The results are given in tables 1-3. Of the nine readings just east of wall 17, ground floor, only three had velocities greater than 9000 fps. This section had not been grouted and apparently contained concrete of inferior quality. The R wall, main lobby, first floor, produced readings ranging between 12,145 and 13,740 fps. These readings indicate concrete of generally good quality. However, the problem of inaccessibility caused readings to be confined to a small portion of the wall. This section of the R wall had been grouted, and there is a possibility that some of the cracks were not completely filled. All readings taken on the R wall, first floor, between columns 12 and 13 near the garage entrance indicated concrete of generally good quality with the exception of four readings taken to locate an inferior area about 3 ft up from the floor near the entrance.

R-wall beam

8. Eighty-three readings were taken on the R-wall beam at various locations; readings are given in tables 4-8. A section of the beam above the ground-floor lobby between walls 23 and 25, not grouted, produced three straight-through readings indicative of good concrete and eight diagonal readings indicating poor to questionable quality concrete (table 4). It was evident from the tests and from visual observation that extensive cracking was present in this beam. Twenty-four readings were taken on the R-wall beam, first floor, main lobby, between columns 23 and 25 (table 5). This section had been grouted. Only three readings were less than 10,000 fps, and 14 were more than 12,000 fps. The indications here are that although some cracks were apparently not filled, the general condition of the section ranged from questionable to good. The R-wall beam, first floor

Fig. 2. R wall, main lobby, first floor

Fig. 3. Close-up of R wall, main lobby, showing sealer, grouting nozzle, and core holes

adjacent to wall 17, which had not been grouted, produced only 6 out of 15 straight-through readings above 12,000 fps (tables 6 and 7). Only three diagonal readings were greater than 10,000 fps; the remaining seven ranged between 4160 and 9215 fps. These readings indicate extensive cracking, inferior quality concrete, or both in this section of the beam. Two readings were taken through replaced concrete in this section of the beam, producing velocities of 15,625 and 16,395 fps. The third floor R-wall beam between walls 14 and 15 produced six straight-through readings greater than 13,000 fps and two at 11,495 fps (table 8). Of the five diagonal readings taken, two were below 12,000 fps and three were below 9000 fps. Although this section had not been grouted, the straight-through readings indicated generally good quality concrete, and the diagonal readings indicated some cracking.

Wall 17

9. One hundred and twelve readings were taken on various sections of wall 17 The results of these readings are given in tables 9-12. The ground-floor section of wall 17 immediately adjacent to the L wall and southward above the ceiling toward the kitchen seemed to be in generally good condition although some cracking was indicated. As reported in tables 9 and 10, all but two straight-through readings were above 12,000 fps. Only five of 15 diagonal readings were below 10,000 fps. This section had not been grouted. Seventy-seven readings taken on the grouted section of wall 17, first floor, above elevator door 5 (table 11) and opening into litters room A-183 (table 12) produced only three velocities below 10,000 fps. The remainder of the readings ranged between 10,520 and 14,910 fps, with 57 readings at 12,500 fps or above.

L wall

10. The results of soniscope tests made on the L wall are given in tables 13 and 14. All tests on the L wall were confined to a section at the ground-floor level. This section had not been grouted. Of 25 straight-through measurements made on the section by duct space 2, only two were below 13,500 fps. Twelve diagonals read in this area indicated some minor cracking. In an adjacent section of the L wall by stairway 1, three of 13 straight-through velocities were below 13,000 fps. The diagonal readings averaged 7540 fps, and indicated that this section

contained more severe cracking than the section by duct space 2.

Wall 19 in duct space 2

11. Selective coring and results of ultrasonic testing revealed that full penetration by epoxy grouting had not been obtained in some cases. Therefore it was decided that one wall should be designated as a test panel; that cracks should be sealed on both faces of the wall; and that the wall should be pumped to refusal with epoxy grout, progressing from low to high elevation. A section of wall 19 in duct space 2 was chosen and the above procedure was followed (fig. 4). Pulse-velocity measurements were made on the test panel prior to grouting, 24 to 48 hr after grouting, and 72 to 96 hr after grouting (table 15). The 14 readings taken 24 to 48 hr after grouting showed velocity increases ranging between 0.6 and 48 percent, with an average increase of approximately 19 percent. The very small increases occurred at points where there was very little cracking and high velocities were obtained with the first reading. When compared with the 24- to 48-hr readings, the readings taken 72 to 96 hr after epoxy repair showed an average decrease in velocity of slightly less than 2 percent. This decrease after extended curing of the epoxy is not surprising in the light of results of the tests discussed in paragraph 23. The 24- to 48-hour readings taken at stations K, L, and M were at least 795 fps lower than the eleven other 24- to 48-hr readings. These readings showed an average increase of only 14 percent instead of the expected average increase of about 19 percent. Check readings at these stations produced the same results. A core was taken through a visible crack near sta 4 on the line between sta A and sta K, L, and M. This core revealed a large unfilled crack between sta A and sta K, L, and M which accounts for the low readings obtained at these stations. The results obtained from velocity tests performed on this section of wall 19 indicate that significant increases in the ultrasonic pulse velocities can be effected in damaged concrete by epoxy grouting if the proper procedures are followed.

Third-floor spandrel beam

12. Between columns 13 and 14. Twelve readings were taken on the interior section of the third-floor spandrel beam which had not been

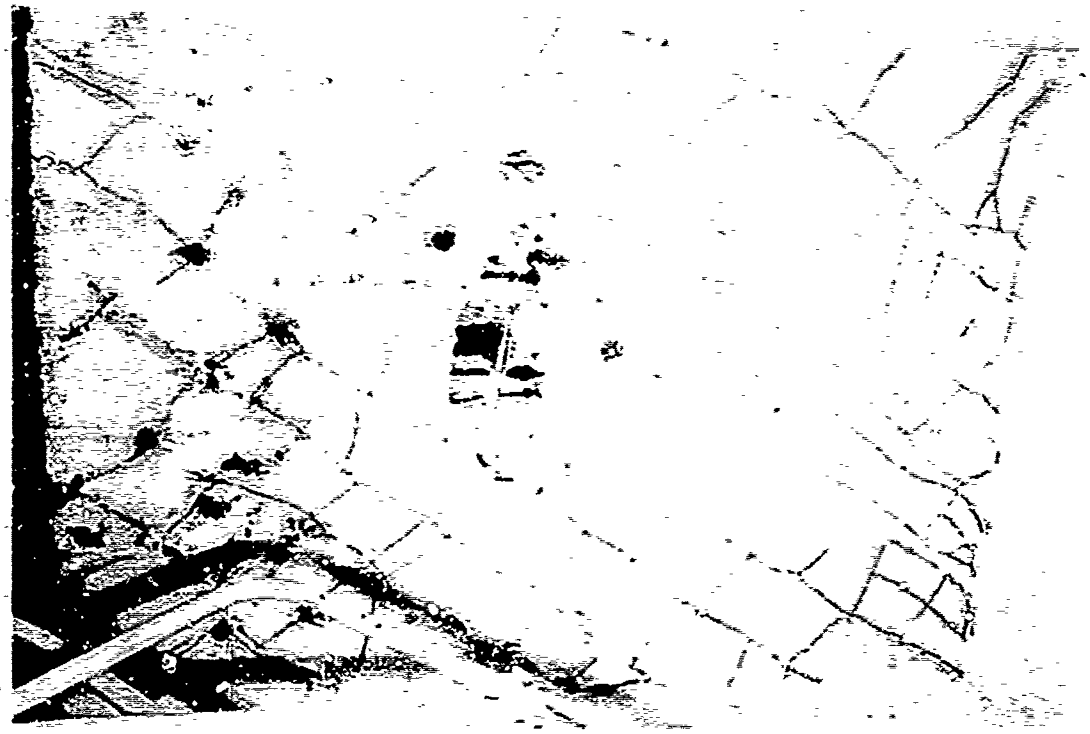

Fig. 4. Wall 19 in duct space 2, test panel

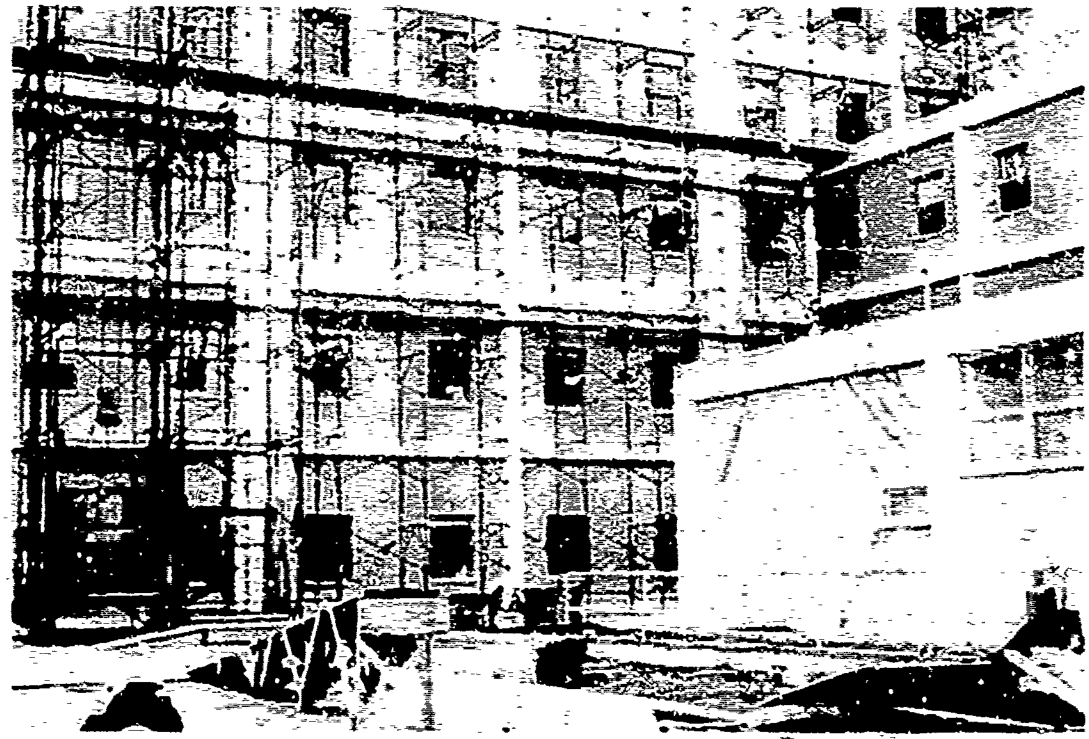

Fig. 5. Third-floor spandrel beam (first wide beam) and columns 8 (wide), 10, and 12 (wide)

grouted (table 16). The four straight-through readings indicated concrete of generally good quality. Velocities obtained by taking diagonal measurements indicated concrete quality from very poor to good. The low diagonal velocities indicated the presence of severe cracking.

13. Beam and column readings, north side. Results of readings designed to determine the general condition of beams, columns, and column-beam connections along the entire third-floor spandrel beam between columns 2 and 13, north side, are given in table 17. This entire section had been grouted. All straight-through readings were above 14,000 fps with the exception of one reading of 13,765 fps. Most of the diagonal readings on this section ranged between 10,000 and 15,000 fps. The high and low readings within this range seemed to be well distributed along the beam with no particular grouping pattern. These readings (10,000 to 15,000 fps) indicated conditions ranging from partially filled cracks to undamaged concrete. Seven diagonal readings were below 10,000 fps. Three of these readings, which were significantly low, were taken through the east column-beam connection at column 8. Unrepaired cracking was suspected at this connection. Two of the low readings were obtained in a section of the spandrel beam between column 2 and about midway of the beam west of column 2.

14. Readings were taken through the outer 6 in. of column-beam connections at columns 8, 10, and 12 (fig. 5) to determine the extent of penetration in the outer face. The locations of these stations and the resul of tests are recorded in tables 18, 19, and 20.

15. Beam and column readings, south side. Readings similar to those taken on the third-floor spandrel beams and columns on the north side were also taken on the south side of the building. However, due to inaccessibility, readings were confined to the vicinity of the column-beam connections. Columns and beams had been grouted up to column 8; no grouting had been accomplished at columns 8, 10, 12, and 14. The grouting seemed to make very little difference in the general condition of the column-beam connection readings. This fact is evidenced in the following tabulation.

Column	Average Reading, fps	Remarks
4*	10,835	Four of 12 below 10,000 fps
6*	13,275	One of 12 below 12,000 fps
8	13,020	Three of 12 below 12,000 fps
10	12,380	Five of 20 below 10,000 fps
12	12,110	Three of 24 below 10,000 fps
14	12,160	One of 12 below 10,000 fps

* Grouted.

At three of these columns, readings indicated that the column-beam connections on one side of the column contained more cracking than the other side. This condition was indicated on the west side of columns 14 and 8, and on the east side of column 10. Station locations and results for this section are given in tables 21-26.

16. Column-beam readings through the outer 6 in. were taken at column 10 to check for penetration of epoxy. All readings produced velocities above 13,000 fps. Station references and results of readings are given in table 27.

Fifth-floor spandrel beam and column connections, north side

17. Velocity measurements were made through the outer 6 in. of column-beam connections on the fifth floor, north side of building, at columns 12 and 10. Results (tables 28 and 29) indicated these connections to be very good at column 10. Three of four measurements at column 12 indicated a good condition.

East stairway wall 2 between wall T and fan room wall

18. Readings were taken in this section on the first, second, third, and fourth floors. Results of the tests in this area are given in tables 30-33. Extensive cracking was indicated on the first floor along with a trend toward less extensive cracking in the higher floors. Most severe cracking occurred around door openings.

Wall 13, mechanical equipment room B-254A

19. Results of the 29 readings taken in this area are given in table 34. The eight diagonal readings taken in the area between the large ducts ranged between 11,710 and 15,120 fps, indicating that some cracking

was present. The absence of any very low readings seems to indicate that the cracking was of a minor nature. Severe cracking was indicated near the south side of the door and in an area above the south side of the door.

Column-beam connections
around outpatient clinic

20. Eight readings were taken at five exterior columns around the outpatient clinic (fig. 6) in an attempt to determine the effectiveness of the epoxy repair. Inaccessibility of interior faces of these columns and beams limited the type and number of readings that could be taken. The location and results of these readings are given in table 35.

Interior column 6 at S wall

21. Two measurements were taken on this interior column for the purpose of comparing the velocities with those of exterior columns. Velocities of 13,700 and 13,940 fps were obtained. The velocities of exterior columns on the main shear walls generally ranged between 14,500 and 16,000 fps.

Second-floor slab

22. Three readings were taken in a patched area of the floor slab, second floor, near elevator 5. The velocity in the new concrete was 14,540 fps; the velocity in the old concrete was 12,500 fps; the velocity from old to new was 7550 fps. This low velocity from old to new concrete indicates a poor bond between the old and new concrete.

Epoxy-repaired cores

23. A test designed to determine the effect, if any, of epoxy repair on pulse velocity was performed on three 4-in.-diameter cores taken from the L wall, ground floor. These cores were broken transversely, and then repaired with layers of epoxy of different thicknesses. One core contained only a film of epoxy to form the bond. The other two were repaired with 1/16- and 1/8-in. layers, respectively. After repair, the specimens were cured for 24 hr at a temperature between 70 and 80 F, and then dried in an oven for 24 hr at a temperature of 150 F. The temperature was then reduced to 120 F for a period of 43 hr. Velocity measurements were made on the cores before breaking and after each phase in the curing process. To obviate any effect that drying of the specimens

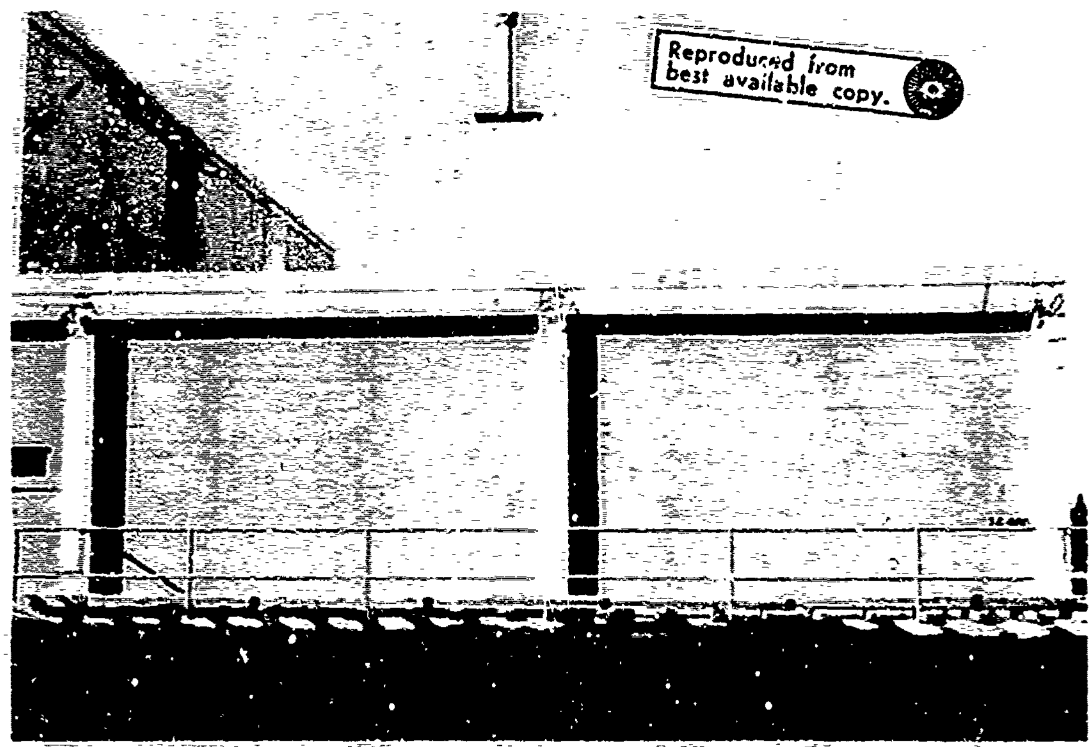

Fig. 6. East wall of outpatient clinic area showing column C, column B, and corner column A

might have on pulse velocity, the cores were saturated with water for an initial reading prior to breaking and the final reading after repair. The results of these tests (table 36) show only a 5.6 percent average decrease in pulse velocity after breakage and epoxy repair. A decrease of 3 to 4 percent in pulse velocity occurred between the readings taken after 24 hr of curing at room temperature and the readings taken after accelerated curing in the oven. This decrease seems to be in line with a slight decrease noted in velocities obtained in tests performed on wall 19 when the epoxy was at about these same ages (see paragraph 11).

Other Tests and Results

Compressive strength

24. A 4-in.-diameter core (core 1) taken from the R wall, main lobby, first floor, and a similar core (core 2) taken from the L wall by stairway 1, ground floor, were taken to the Concrete Branch testing laboratory, Alaska District, for compressive strength tests. The specimens were capped and tested in accordance with CRD-C 14-63.[1] Pulse velocity measurements were made on the cores prior to capping and breaking. Results of these tests are given in the following tabulation.

Core	Compressive Strength psi	Pulse Velocity fps
1	4876	13,870
2	5444	14,880

The limited amount of data obtained from these tests precludes the establishment of any reliable correlation between pulse velocity and compressive strength. However, these data conform to the generally expected pattern of a higher pulse velocity with a higher compressive strength.

Tensile splitting

25. Tests were performed on eight 2-in.-diameter cores to compare the tensile-splitting strength of the epoxy bond in cracked concrete with that of the undamaged concrete. Procedures outlined in test method CRD-C 77-61[1] were followed with the exception that 2-in. cores were tested.

The results of these tests are given in the following tabulation.

Specimen	Tensile-Splitting Strength, psi
1	588.4
1C	441.0
2C	682.4
3C	494.4
1E	822.0
2E	861.4
3E	665.5
4E	378.5

Specimen 1 was part of an undamaged core taken from the test panel, wall 19. Specimens 1C, 2C, and 3C were cut from a single core of repaired concrete taken from the same wall. Specimens 1E-4E were cut from a single core of repaired concrete also taken from the test panel, wall 19. Although the epoxy-repaired cracks did not run entirely parallel to the specimen axes, the specimens were loaded as nearly as possible along the repaired openings. Four of the seven repaired specimens failed at strengths considerably greater than that of the undamaged specimen. The other three showed strengths from 15 to 35 percent less than that of the undamaged specimen. However, the most significant fact derived from these tests was that the break in each repaired specimen occurred along the axis of the specimen and not along the line of epoxy repair. This indicates that the epoxy bond was at least as strong as the adjacent undamaged concrete in the specimen.

PART IV: CONCLUSIONS

26. Representative velocities of good concrete in the L wall, spandrel beams, and columns ranged between 14,000 and 15,000 fps. Other areas exhibited velocities between 13,000 and 14,000 fps in good concrete. All sections tested exhibited some low velocities in straight-through as well as diagonal readings. Low velocities were far more prevalent in ungrouted sections.

27. Significant increases in ultrasonic pulse velocities can be effected in damaged concrete by epoxy grouting if proper procedures are followed. However, velocities obtained after repair will probably be about 6 percent lower than velocities in the original undamaged concrete. Sealing both faces of an area of concrete and pumping to refusal while progressing from low to high elevations seemed to be the best method for attaining effective repair by epoxy grouting in the areas tested during this investigation.

28. Results of compressive strength-pulse velocity tests, though limited, indicate that the compressive strength of the concrete in the hospital building probably ranges between 4000 and 5000 psi, and that concrete of this quality will probably produce pulse velocities ranging between 13,000 and 15,000 fps. Results of tensile-splitting tests indicate that cracked concrete when properly repaired with epoxy grout is as strong as the adjacent original concrete.

29. It is indicated from the test results that there are areas within the structure where repair by epoxy grout is not complete. There is some question of whether further penetration could be obtained in areas that have already been pumped unless pumping is done from the opposite face.

30. It is further concluded that ultrasonic testing is a rapid, economical, and satisfactory method of detecting cracked or otherwise inferior quality concrete, and that indications of the state of repair of the concrete can be derived from test results.

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Table 1

Results of Soniscope Tests

R Wall East of Wall 17 Between Ground and 1st Floor

(Not Grouted)

	Station References			Velocities fps		
Station Numbers	Distance Down from 1st Floor in.	Distance East from Wall 17 in.	Path Length ft	Straight Through	Diagonals	Remarks
83	40	7				Only one side accessible
85	20	20				Only one side accessible
87	60	20				Only one side accessible
88	20	40				Only one side accessible
89	40	40	1.00	12,660		
90	60	40	1.00	9,345		
91	20	60				Only one side accessible
92	40	60	1.00	12,985		
93	40	100				Only one side accessible
94	60	100				Only one side accessible
83 to 90			3.32		3905	
87 to 89			2.54		7470	
85 to 89			2.54		5425	
88 to 92			2.54		5315	
91 to 94			4.85		5160	
92 to 93			3.48		7280	

Table 2

Results of Soniscope Tests

R Wall, Main Lobby, 1st Floor

(Grouted)

Station Numbers	Station References: Distance from East Face in.	Station References: Distance from Floor in.	Path Length ft	Velocities fps: Straight Through	Velocities fps: Diagonals
101	28	112	1.00	13,700	
102	34	78	1.00	13,330	
103	34	67	1.00	13,150	
104	34	35	1.00	12,660	
105	35	17	1.00	13,330	
106	20	112	1.00	12,500	
107	24	61	1.00	13,150	
108	23	35	1.00	13,330	
109	8	109	1.00	13,150	
110	8	68	1.00	13,330	
101 to 109			1.98		12,145
102 to 109			3.64		12,860
102 to 110			2.58		12,525
104 to 110			3.64		13,095
105 to 108			2.02		13,740

Table [illegible]

Results of Soniscope Tests

R Wall, 1st Floor Between Columns 12 and 13

East of Outside Entrance Next to Garage

(Grouted)

Station Number	Station Reference: Distance Above Hole* Center, in.	Distance From Center, in.: West	Distance From Center, in.: East	Path Length ft	Velocities, fps: Straight Through	Velocities, fps: Diagonal	Remarks
126	21	[illegible]		1.00	13,[illegible]		
127	11	[illegible]		1.00	13,7[illegible]		
128	0	[illegible]		1.00	[illegible]		
129	21	[illegible]		1.00	13,[illegible]		
130	12	[illegible]		1.00	13,[illegible]		
131	[illegible]		10	1.00	14,[illegible]		
132	0		10	1.00	1[illegible]		
133	12		20	1.00	1[illegible]		
134	0		20	1.00	1[illegible]		
135	21		26	1.00	13,[illegible]		
136	12		34	1.00	13,[illegible]		
137	0		34	1.00	13,[illegible]		
138	21		43	1.00	14,[illegible]		
139	12		43	1.00	14,[illegible]		
140	0		43	1.00	1[illegible]		
127 to 128				1.[illegible]		1[illegible],735	
128 to 130				1.51		14,[illegible]	
131 to 132				1.42		13,150	
133 to 134				1.42		[illegible],150	
129 to 135				2.37		13,[illegible]	
1[illegible] to 13[illegible]				[illegible].77		[illegible],1[illegible]	
139 to 140				1.[illegible]		13,7[illegible]	

Readings Taken to Locate Suspected Inferior Concrete in One Section of Wall

Station Number	Path Length ft	Velocities, fps: Diagonal	Remarks
Station 134 to points along an arc 2.14 ft from station 134 across suspected area	2.14 2.14 2.14 2.14	13,[illegible] 13,[illegible] 13,[illegible] 13,[illegible]	Indicates this crack filled
Station 134 to points along an arc 4.0 ft from station 134 across suspected area	4.00 4.00 4.00 4.00 4.00	11,6[illegible]0 [illegible],[illegible]0 11,[illegible]30 13,20[illegible] 1[illegible],5[illegible]	Indicates comparatively inferior area about [illegible] ft up from floor near entrance
Station 128 to points along an arc 16 in. below station 128 in good area just above suspected area	1.67 1.67 1.67	13,[illegible]00 13,465 13,4[illegible]	Indications good
Station 128 to points along an arc 3.04 ft below station 128 just below suspected area	3.20 3.20 3.20	13,[illegible] 13,[illegible] 12,1[illegible]	Indications good
Station 128 to points along an arc 2.17 ft below station 128 in suspected area	2.3[illegible] 2.3[illegible] 2.3[illegible] 2.3[illegible]	12,[illegible] 12,[illegible] 13,[illegible] 14,000	

* Stations 126 through 140 were referenced from the center of a 4-in. core hole drilled through the wall. The center of the core hole was 65.5 in. up from 1st floor and [illegible].5 in. east of wall 1[illegible].

Table 4

Results of Soniscope Tests

R-Wall Beam Above Lobby, Ground Floor

Between Walls 23 and 25

(Not Grouted)

Station Numbers	Station References: Distance up from Bottom of Beam in.	Station References: Distance West from Wall 23 in.	Path Length ft	Velocities fps: Straight Through	Velocities fps: Diagonals	Remarks
106	37	21	1.08	14,400		
106A	37	25 east of 106				Only one side accessible
107	17	21				Only one side accessible
108	24	71	1.08	13,500		
109	8	95				Only one side accessible
110	24	108				Only one side accessible
111	40	133	1.08	13,170		
112	40	170				Only one side accessible
113	10	165				Only one side accessible
106 to 106A			2.35		11,520	
106 to 108			4.46		9.610	
107 to 108			4.31		11,370	
108 to 109			2.58		7,565	
109 to 111			4.14		7,765	
111 to 112			2.95		11,345	
111 to 113			3.90		8,495	
110 to 111			2.72		7,575	

Table 5

Results of Soniscope Tests

B-Wall Beam Over 1st Floor Opening (Main Lobby)

Between Columns 23 and 25

(Grouted)

Station Numbers	Station References: Distance from Top of Beam in.	Station References: Distance West from Wall 23 in.	Path Length ft	Velocities fps: Straight Through	Velocities fps: Diagonals
111	8	7	1.00	12,050	
112	16	7	1.00	12,990	
113	24	7	1.00	13,160	
114	11	23	1.00	13,160	
115	19	23	1.00	13,890	
116	26	23	1.00	12,195	
117	12	89	1.00	11,630	
118	20	89	1.00	10,525	
119	9	96	1.00	13,485	
120	15	96	1.00	13,955	
121	23	96	1.00	13,185	
122	17	132	1.00	14,490	
123	8	174	1.00	12,345	
124	17	174	1.00	13,160	
125	24	174	1.00	12,820	
119 to 122			3.00		10,675
120 to 122			3.17		11,830
121 to 122			3.57		10,230
111 to 116			2.17		7,210
112 to 115			1.60		11,345
117 to 118			1.25		9,540
122 to 125			3.64		10,225
122 to 124			3.64		15,825
122 to 123			3.72		8,435

Table 6

Results of Soniscope Tests

R-Wall Beam, 1st Floor Adjacent to Wall 17

Between Columns 16 and 17

(Not Grouted)

Station Numbers	Station References: Distance from Wall 17 in.	Station References: Distance from Floor Above in.	Path Length ft	Velocities fps: Straight Through	Velocities fps: Diagonals
172	3	21	1.00	11,630	
173	3	39	1.00	10,990	
174	3	51	1.00	10,990	
175	15	21	1.00	10,640	
176	15	39	1.00	9,900	
177	15	51	1.00	13,700	
178	24	21	1.00	10,755	
179	24	39	1.00	13,160	
180	24	51	1.00	12,500	
181	44	21	1.00	12,195	
182	44	39	1.00	12,500	
183	44	51	1.00	12,660	
172 to 176			2.02		6,435
175 to 179			2.05		7,195
174 to 177			1.42		11,360
180 to 182			2.23		9,215
179 to 183			2.23		8,545
178 to 182			2.53		6,875
179 to 181			2.47		11,175
181 to 184			1.80		6,520
181 to 185			2.17		6,975
Two Readings Taken Through Replaced Concrete in R-Wall Beam					
F			1		16,395
G			1		15,625

Table 7

Results of Soniscope Tests

R-Wall Beam, 1st Floor Between Columns 16 and 17

(Not Grouted)

Station Numbers	Station References: Distance East of Opening in Beam in.	Station References: Distance Down from Floor Above in.	Path Length ft	Velocities fps: Straight Through	Velocities fps: Diagonals
1001	15	40	1.00	11,365	
1002	24	57	1.00	10,310	
1003	31	55	1.00	6,370	
1001 to 1002			1.95		10,315
1001 to 1003			2.08		6,730
Readings from Station 1002 to Points Along an Arc 46 in. East of Station 1002					
1002 to 1004			3.98		8,075
1002 to 1005			3.98		4,160
1002 to 1006			3.98		5,190
1002 to 1007			3.98		6,495
1002 to 1008			3.98		6,150
1002 to 1009			3.98		6,105
1002 to 1010			3.98		8,010

Table 8

Results of Soniscope Tests

R-Wall Beam Between Walls 14 and 15

Between 2d and 3d Floors

(Not Grouted)

	Station References			Velocities fps	
Station Numbers	Distance from East Side of Large Duct Opening in.	Distance Down from 3d Floor in.	Path Length ft	Straight Through	Diagonals
201	40	20	1.00	13,335	
202	40	40	1.00	13,335	
203	80	20	1.00	13,160	
204	80	40	1.00	13,700	
205	120	20	1.00	13,160	
206	120	40	1.00	13,160	
207	160	20	1.00	11,495	
208	160	40	1.00	11,495	
201 to 204			3.88		11,280
202 to 203			3.88		7,670
203 to 206			3.88		10,265
204 to 205			3.88		7,565
206 to 207			3.88		8,170

Table 9

Results of Soniscope Tests

Wall 17 Adjacent to L Wall Between Ground and 1st Floor

(Not Grouted)

Station Numbers	Station References: Distance Down from 1st Floor in.	Station References: Distance from North Face, R Wall, in.	Path Length ft	Velocities fps: Straight Through	Velocities fps: Diagonals	Remarks
40X	20	293		13,890		Only one side accessible
41	20	293				Only one side accessible
42	37	293	1.00	13,890		
43	57	293				Only one side accessible
45	20	265				Only one side accessible
46	37	265	1.00	13,515		
47	57	265	1.00	13,890		
49	20	222				Only one side accessible
51	57	222				Only one side accessible
57	57	183				Only one side accessible
40X to 41			1.95		9,375	
41 to 47			2.38		7,040	
42 to 47			3.00		12,875	
42 to 45			2.84		12,455	
43 to 46			3.08		14,810	
45 to 51			4.70		13,705	
49 to 57			4.62		8,265	

Table 10

Results of Soniscope Tests

Wall 17 in Duct Space 2

(Not Grouted)

	Station References			Velocities, fps	
Station Numbers	Distance from Ground Floor in.	Distance from North Face of L Wall in.	Path Length ft	Straight Through	Diagonals
95	102	50	1.00	13,335	
96	79	50	1.00	11,495	
97	62	50	1.00	11,495	
98	42	50	1.00	12,050	
99	102	80	1.00	14,085	
100	79	80	1.00	13,700	
101	62	80	1.00	13,515	
102	42	80	1.00	13,335	
103	102	110	1.00	13,890	
104	102	140	1.00	14,705	
105	102	180	1.00	14,705	
95 to 99			2.75		9,965
96 to 99			3.33		11,935
96 to 101			2.84		11,935
97 to 102			3.17		12,780
98 to 101			3.17		9,875
100 to 103			3.23		14,815
103 to 104			2.75		12,500
104 to 105			3.48		12,385

Table 11

Results of Soniscope Tests

Wall 17 Adjacent to R Wall Between 1st and 2d Floors

Above Elevator Door 5

(Grouted)

	Station References			Velocities, fps	
Station Numbers	Distance from R Wall, in.	Distance from Floor Above, in.	Path Length ft	Straight Through	Diagonals
141	10	10	1.00	12,500	
142	10	18	1.00	12,500	
143	10	42	1.00	12,820	
144	10	54	1.00	12,500	
145	32	10	1.00	12,500	
146	32	18	1.00	12,820	
147	32	42	1.00	12,500	
148	32	54	1.00	12,500	
149	44	10	1.00	12,985	
150	44	18	1.00	12,985	
151	44	42	1.00	11,495	
152	44	54	1.00	12,050	
153	59	10	1.00	13,890	
154	59	18	1.00	13,890	
155	59	42	1.00	10,870	
156	59	54	1.00	12,500	
142 to 146			2.08		12,235
143 to 147			2.08		12,235
145 to 149			1.42		11,640
147 to 151			1.42		11,640
146 to 150			1.42		9,660
149 to 153			1.60		12,030
150 to 154			1.60		12,500
151 to 155			1.60		9,940
152 to 156			1.60		10,740
150 to 155			2.50		12,565
152 to 155			1.99		13,355
142 to 147			2.88		10,705
147 to 149			[illegible].00		12,[illegible]

(Continued)

Table 11 (Concluded)

Station Numbers	Station References: Distance from R Wall, in.	Station References: Distance from Floor Above, in.	Path Length ft	Velocities, fps: Straight Through	Velocities, fps: Diagonals
186	71	10	1.00	12,820	
187	71	18	1.00	14,085	
188	71	42	1.00	12,500	
189	71	54	1.00	13,515	
190	93	10	1.00	13,160	
191	93	18	1.00	12,050	
192	93	42	1.00	13,160	
193	93	54	1.00	12,820	
194	117	10	1.00	12,820	
195	117	18	1.00	12,820	
196	117	42	1.00	12,820	
197	117	54	1.00	13,335	
190 to 194			2.23		13,435
191 to 195			2.23		10,520
187 to 192			2.47		13,645
192 to 196			2.23		14,295
196 to 197			1.42		11,450
190 to 191			1.20		13,150
187 to 188			2.23		11,265
188 to 189			1.42		12,455
155 to 156			1.42		7,170
155 to 187			2.47		11,705
	Readings Through Replaced Concrete in South Side of Door, Litters Room A-183				
A	12	10	1.00	14,570	
B	24	12	1.00	14,570	
C	36	10	1.00	14,510	
D	48	10	1.00	14,510	
E	60	10	1.00	14,510	
A to E			4.15		15,090

Table 12

Results of Soniscope Tests

Wall 17 Between 1st and 2d Floors Above Opening

into Litters Room A-183

(Grouted)

Station Numbers	Station References: Distance from North Wall in.	Station References: Distance from Floor Above in.	Path Length ft	Velocities fps: Straight Through	Velocities fps: Diagonals
157	10	12	1.00	13,700	
158	10	31	1.00	14,085	
159	10	55	1.00	13,700	
160	21	12	1.00	14,285	
161	21	31	1.00	13,890	
162	21	55	1.00	13,160	
163	36	12	1.00	14,285	
164	36	31	1.00	13,700	
165	36	55	1.00	13,700	
166	53	12	1.00	13,700	
167	53	31	1.00	13,890	
168	53	55	1.00	14,085	
169	77	12	1.00	15,150	
170	77	31	1.00	14,285	
171	77	55	1.00	13,700	
167 to 169			2.83		13,605
166 to 170			2.73		12,295
168 to 170			3.00		13,335
167 to 171			3.00		14,285
164 to 168			2.62		14,475
164 to 165			2.23		13,435
163 to 164			1.98		13,240
157 to 164			2.97		13,260
158 to 162			2.39		13,060
159 to 161			2.39		13,060
160 to 163			1.67		14,910

Table 13

Results of Soniscope Tests

L Wall by Duct Space 2

Ground Floor Level

(Not Grouted)

	Station References			Velocities fps	
Station Numbers	Distance from East Face Wall 17 in.	Distance up from Floor in.	Path Length ft	Straight Through	Diagonals
1	56-1/4	114	1.00	14,495	
2	56-1/4	97	1.00	14,495	
3	56-1/4	85	1.00	14,495	
4	56-1/4	65	1.00	14,085	
5	56-1/4	49	1.00	13,890	
6	71-1/4	114	1.00	14,495	
7	71-1/4	97	1.00	14,495	
8	71-1/4	85	1.00	14,495	
9	71-1/4	65	1.00	13,890	
10	71-1/4	49	1.00	13,700	
11	86-1/4	114	1.00	14,085	
12	86-1/4	97	1.00	14,710	
13	86-1/4	85	1.00	14,085	
14	86-1/4	65	1.00	13,890	
15	86-1/4	49	1.00	14,285	
16	101-1/4	114	1.00	14,085	
17	101-1/4	97	1.00	14,925	
18	101-1/4	85	1.00	14,495	
19	101-1/4	65	1.00	12,820	
20	101-1/4	49	1.00	12,195	
21	110-1/4	114	1.00	13,515	
22	110-1/4	97	1.00	14,085	
23	110-1/4	85	1.00	14,285	
24	110-1/4	65	1.00	14,085	
25	110-1/4	49	1.00	13,700	

(Continued)

Table 13 (Concluded)

Station Numbers	Station References: Distance from East Face Wall 17 in.	Station References: Distance up from Floor in.	Path Length ft	Velocities fps: Straight Through	Velocities fps: Diagonals
1 to 8			2.84		11,270
3 to 6			2.84		12,085
3 to 10			3.48		9,750
5 to 8			3.48		11,715
6 to 13			2.93		11,015
8 to 11			2.84		9,190
8 to 15			3.48		12,565
10 to 13			3.48		12,125
10 to 23			3.33		8,495
13 to 21			3.33		12,020
13 to 25			3.80		10,735
15 to 23			3.80		11,985

Table 14

Results of Soniscope Tests

L Wall, Ground Floor by Stairway 1

(Not Grouted)

Station Numbers	Station References: Distance from East Face Wall 17 in.	Station References: Distance up from Floor in.	Path Length ft	Velocities, fps: Straight Through	Velocities, fps: Diagonals
26	180	114	1.08	10,000	
27	180	85	1.08	10,485	
28	180	49	1.08	10,095	
29	240	114	1.08	13,670	
30	240	85	1.08	14,025	
31	240	49	1.08	13,670	
32	240	13	1.08	14,025	
34	300	114	1.08	13,335	
35	300	85	1.08	13,170	
36	300	13	1.08	14,595	
38	348	85	1.08	13,670	
39	348	49	1.08	13,500	
40	348	13	1.08	13,170	
25 to 26			9.30		6,815
22 to 28			7.89		7,108
26 to 30			4.77		8,565
28 to 30			5.10		7,390
27 to 29			4.77		8,265
27 to 31			5.10		6,735
29 to 34			5.59		6,600
31 to 34			5.92		6,400
34 to 39			5.18		10,635
35 to 38			5.10		8,715
30 to 35			5.92		5,690

Table 15

Results of Soniscope Tests

Wall 19 in Duct Space 2

(Test Panel)

Station Designation	Path Length ft	9/2/64 Before Repair	24 to 48 hr After Repair	72 to 96 hr After Repair
A*	1.00	12,660	14,285	13,515
A to B	2.08	11,125	13,080	13,165
A to C	2.17	10,795	13,310	12,615
A to D	2.84	6,650	12,680	12,085
A to E	2.31	7,175	12,905	12,625
A to F	3.00	9,375	13,160	12,820
A to G	3.48	9,720	12,795	12,935
A to H	3.64	14,108	14,445	14,680
A to I	3.48	12,745	14,380	14,320
A to J	3.96	10,180	13,380	13,070
A to K	2.53	8,665	11,345	11,450
A to L	2.08	11,685	11,885	12,310
A to M	2.30	9,745	11,560	10,550
A to N	2.01	13,225	13,310	13,225

* All readings taken diagonally through wall except at point A where straight-through readings were taken. Point A located 90 in. from ground floor and 42 in. south of L wall.

Table 16

Results of Soniscope Tests

3d Floor Spandrel Beam

Between Columns 13 and 14

(Not Grouted)

(North Side)

Station Numbers	Station References: Distance from West End of Beam in.	Station References: Distance up from Bottom of Beam in.	Path Length ft	Velocities fps: Straight Through	Velocities fps: Diagonals	Remarks
209	13	17	1.17	14,625		
210	13	3	1.17	13,295		
211	43	17	1.17	13,765		
212	43	3	1.17	13,765		
213	83	15-1/2				Only one side accessible
214 (13-14)*	83	3				Only one side accessible
208** to 209			4.12		3,680	
208 to 210			3.64		6,895	
209 to 211			2.75		12,010	
209 to 212			2.99		10,275	
212 to 213			3.69		7,305	
211 to 213			3.53		12,050	
214 to BT	53 east of point 214	25-1/2	4.58		8,910	
214 to BU	49 east of point 214	5-1/2	4.25		10,045	

* Numbers in parentheses indicate columns between which the station was located.

** On R-wall beam, see table 8.

Table 17

Results of Soniscope Tests

3d Floor Spandrel Beam; Readings Through Beams, Columns, and

Column-Beam Connections

(Grouted)

(North Side)

Station Numbers	Station References: Distance from West End of Beam in.	Station References: Distance up from Bottom of Beam in.	Path Length ft	Velocities, fps: Straight Through	Velocities, fps: Diagonals
215 (12-13)*	165	15-1/2	1.17	14,695	
216 (on col 12)	227	6	1.17	14,6[illegible]5	
215 to 216			5.38		10,055
215 to BT	34 west of point 215	25-1/2	3.07		11,810
215 to BU	34 west of point 215	5-1/2	3.07		14,550
216 to BR	36 west of point 216	25-1/2	[illegible]		13,52[illegible]
216 to BS	36 west of point 216	5-1/2	[illegible]		14,440
216 to BP	42 east of point 216	25-1/2	3.69		13,665
216 to BQ	42 east of point 216	5-1/2	3.69		13,570
217 (10-12)	299 east of col 13	15-1/2	1.17	14,695	
218 (10-12)	362 east of col 13	15-1/2	1.17	14,445	
219 (10-12)	428 east of col 13	15-1/2	1.17	14,625	
220 (on col 10)	500 east of col 13	15-1/2	1.17	13,765	
221 (8-10)	566 east of col 13	15-1/2	1.17	14,445	
217 to BP	35 west of point 217	25-1/2	3.14		14,275
217 to BQ	32 west of point 217	5-1/2	2.91		14,060
217 to 218			5.30		12,010
218 to 219			[illegible]		14,190
219 to BN	37 east of point 219	25-1/2	3.30		12,693
219 to BO	37 east of point 219	5-1/2	3.30		12,315
220 to BN	38 west of point [illegible]0	25-1/2	3.38		11,575
220 to BO	38 west of point 220	5-1/2	3.38		13,575
220 to BL	13 east of point 220	25-1/2	1.57		11,545
220 to BM	13 east of point 220	5-1/2	[illegible]		12,765
220 to 221			5.43		12,455
221 to BJ	43 east of point 221	25-1/2	3.77		12,525
221 to BK	43 east of point 221	5-1/2	3.77		[illegible]
222 (8-10)	647 east of col 13	15-1/2	1.17	14,625	
223 (8-10)	716 east of col 13	15-1/2	[illegible]	14,625	
224 (middle col 8)	750 east of col 13	13-1/2	1.17	15,000	
222 to BJ	40 west of point 222	25-1/2	3.52		13,[illegible]5
222 to BK	40 west of point 222	5-1/2	3.52		9,[illegible]30
222 to 223			5.8[illegible]		14,005
223 to 8A (On col 8)	On a 20-in. arc east of point 223	25-1/2	2.03		11,405
223 to 8B (On col 8)	On a 20-in. arc east of point 223	15-1/2	[illegible].03		11,690
223 to 8C (On col 8)	On a 20-in. arc east of point 223	5-1/2	2.03		13,905
225 (6-8)	32 east of center, col 8	15-1/2	1.17	15,605	
226 (6-8)	112 east of center, col 8	15-1/2	1.17	15,395	
227 (6-8)	212 east of center, col 8	15-1/2	1.17	15,000	
228 (center, col 6)	257 east of center, col 8	11-1/2	1.17	10,[illegible]	

(Continued)

* Numbers in parentheses indicate columns between which the stations were located.

Table 17 (Concluded)

Station Numbers		Station References: Distance from West End of Beam in.	Station References: Distance up from Bottom of Beam in.	Path Length ft	Velocities, fps: Straight Through	Velocities, fps: Diagonal
225 to 224A	On col 8	On a 32-in. arc west of point 225	25-1/2	2.91		6,995
225 to 224B			15-1/2	2.91		6,995
225 to 224C			5-1/2	2.91		7,045
226 to BH		30 west of point 226	25-1/2	2.75		14,4[illegible]5
226 to BI		30 west of point 226	5-1/2	[illegible]		14,4[illegible]
227 to 228				3.[illegible]		13,[illegible]
227 to 228A		45 east of point 227	25-1/2	3.92		14,[illegible]
228 to BF		45 east of point 228	25-1/2	3.92		14,411
228 to BG		43 east of point 228	5-1/2	3.77		14,[illegible]
229 (4-6)		102 east of center, col 6	[illegible]-1/2	1.17	15,250	
230 (4-6)		170 east of center, col 6	15-1/2	1.[illegible]	15,000	
231 (on col 4)		240 east of center, col 6	15-1/2	1.17	[illegible]	
232 (2-4)		303 east of center, col 6	15-1/2	1.17	14,445	
233 (2-4)		464 east of center, col 6	15-1/2			
234 (2-4)		496 east of center, col 6	10-1/2			
229 to BF		57 west of point 229	25-1/2	5.04		13,[illegible]
229 to BG		57 west of point 229	5-1/2	5.04		13,0[illegible]
230 to BD		32 east of point 230	15-1/2	4.91		13,[illegible]
231 to BC	On a 38-in. arc west of 231		25-1/2	3.38		13,630
231 to BD			15-1/2	3.38		13,[illegible]
231 to BE			5-1/2	3.38		11,[illegible]
232 (2-4)		303 east of center, col 6	15-1/2	1.00	14,465	
232 to 4A	On col 4	On a 44-in. arc west of 232	25-1/2	3.55		[illegible]
232 to 4B			15-1/2	3.55		[illegible]
232 to 4C			5-1/2	3.55		[illegible]
233 (2-4)		464 east of center, col 6	15-1/2			
234 (2-4)		496 east of center, col 6	10-1/2			
233 to 234				[illegible]		[illegible]
234 to BA		96 west of point 234	25-1/2	[illegible]		[illegible]
234 to BB		97 east of point 234	5-1/2	[illegible]		[illegible]
234 to 2A	On col 2	27 east of point 234	25-1/2	[illegible]		[illegible]
234 to 2B		24 east of point 234	15-1/2	[illegible]		12,410
234 to 2C		23 east of point 234	5-1/2	[illegible]		14,[illegible]

Table 18

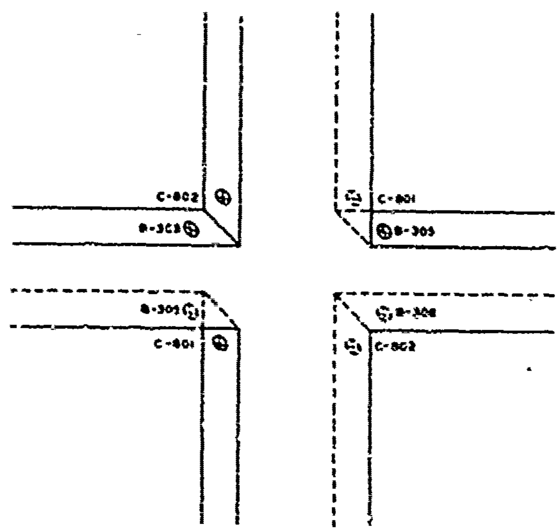
Results of Soniscope Tests

3d Floor Spandrel Beam at Column 8

Column-Beam Readings Through Outer 6 in.

North Side of Building

Station Numbers	Path Length ft	Diagonal Velocities fps
B-305	5.6	13,965
B-306	5.5	12,305
C-801	5.3	13,695
C-802	5.5	14,250



Station location diagram

Table 19

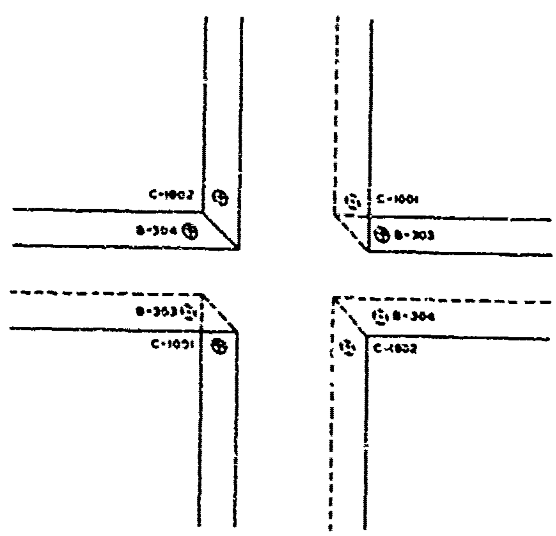
Results of Soniscope Tests

3d Floor Spandrel Beam at Column 10

Column-Beam Readings Through Outer 6 in.

North Side of Building

Station Numbers	Path Length ft	Diagonal Velocities fps
B-303	3.4	12,830
B-304	3.3	12,690
C-1001	3.6	14,575
C-1002	3.7	14,285



Station location diagram

Table [illegible]

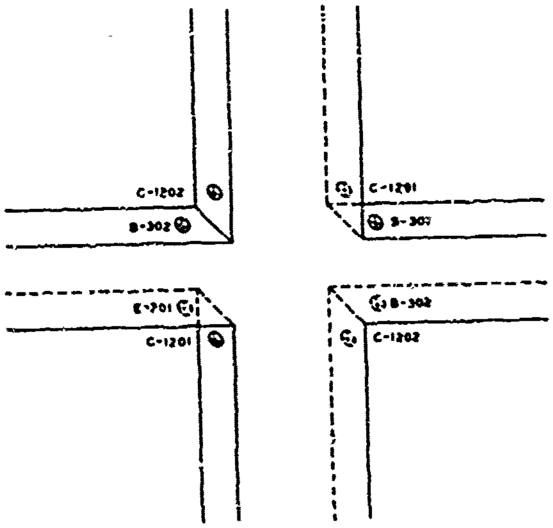
Results of Soniscope Tests

3d Floor Spandrel Beam at Column 12

Column-Beam Readings Through Outer 6 in.

North Side of Building

Station Numbers	Path Length ft	Diagonal Velocities fps
B-301	5.6	13,240
B-302	5.5	9,665
C-1201	5.3	13,250
C-1202	5.4	14,440



Station location diagram

Table 21

Results of Soniscope Tests

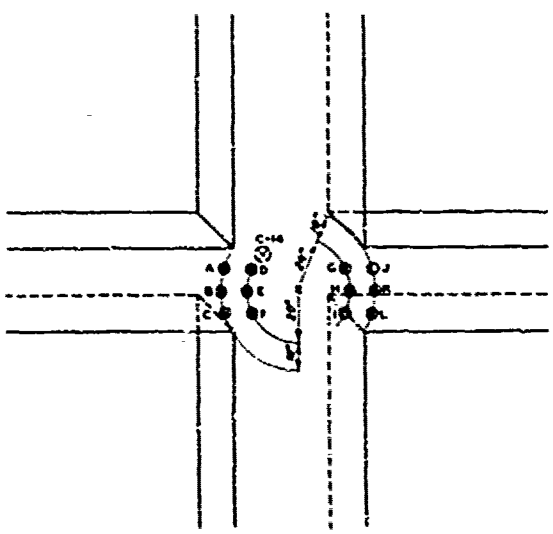
3d Floor Spandrel Beam at Column 14

Readings Through Beams, Columns, and Column-Beam Connections

(South Side)

(Not Grouted)

Station Numbers	Path Length ft	Velocities fps	
		Straight Through	Diagonals
C-14	1.17	13,765	
C-14 to A	2.76		7,095
C-14 to B	2.76		10,000
C-14 to C	2.76		11,550
C-14 to D	2.03		11,215
C-14 to E	2.03		11,800
C-14 to F	2.03		11,665
C-14 to G	2.03		13,810
C-14 to H	2.03		13,810
C-14 to I	2.03		13,810
C-14 to J	2.76		13,730
C-14 to K	2.76		13,730
C-14 to L	2.76		13,730



Station location diagram

Table 22

Results of Soniscope Tests

3d Floor Spandrel Beam at Column 12

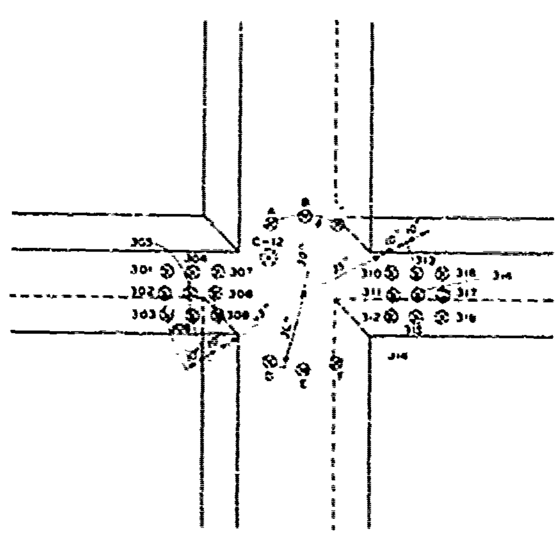
Readings Through Beams, Column, and Column-Beam Connections

(South Side)

(Not Grouted)

Station Numbers	Path Length ft	Velocities fps	
		Straight Through	Diag-onals
C-12	1.17	14,445	
317	1.17	14,625	
C-12 to A	2.76		14,[illegible]00
C-12 to B	2.76		14,840
C-12 to C	2.76		14,605
C C-12 to D	2.76		14,840
C-12 to E	2.76		14,840
C-12 to F	2.76		14,840
C-12 to 301	5.13		12,825
C-12 to 302	5.13		10,470
C-12 to 303	5.13		10,620
C-12 to 304	3.92		8,655
C-12 to 305	3.92		8,200

Station Numbers	Path Length ft	Diagonal Velocities fps
C-12 to 306	3.92	10,890
C-12 to 307	5.14	12,410
C-12 to 308	5.14	12,410
C-12 to 309	5.14	14,080
C-12 to 310	5.14	12,[illegible]60
C-12 to 311	5.14	10,5[illegible]5
C-12 to 312	5.14	1[illegible],[illegible]20
C-12 to 313	[illegible].92	11,665
C-12 to 314	[illegible].92	11,4[illegible]0
C-12 to [illegible]	[illegible].92	11,770
C-12 to 316	5.13	10,160
C-12 to 317	5.13	9,885
C-12 to 318	5.13	10,645



Station location diagram

Table 23

Results of Soniscope Tests

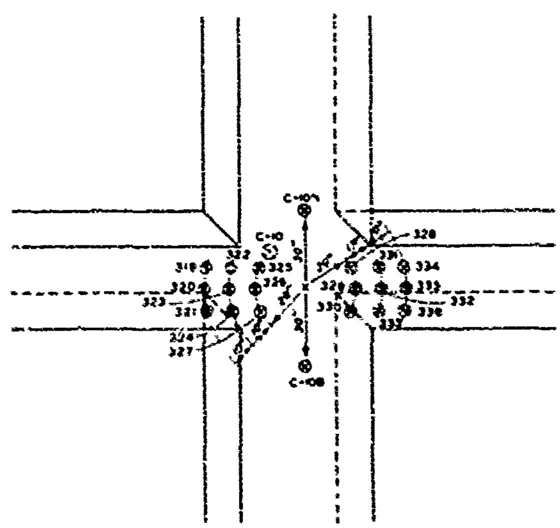
3d Floor Spandrel Beam at Column 10

Readings Through Beams, Column, and Column-Beam Connections

(South Side)

(Not Grouted)

Station Numbers	Path Length ft	Velocities fps Straight Through	Velocities fps Diagonals	Station Numbers	Path Length ft	Diagonal Velocities fps
C-10	1.17	12,825		C-10 to 326	2.03	15,265
335	1.17	14,570		C-10 to 327	2.03	14,195
C-10 to C-10A	2.76		14,525	C-10 to 328	2.03	10,355
C-10 to C-10B	2.76		14,525	C-10 to 329	2.03	9,855
C-10 to 319	3.53		13,420	C-10 to 330	2.03	11,405
C-10 to 320	3.53		13,170	C-10 to 331	2.76	9,585
C-10 to 321	3.53		14,175	C-10 to 332	2.76	10,495
C-10 to 322	2.76		14,300	C-10 to 333	2.76	8,680
C-10 to 323	2.76		15,080	C-10 to 334	3.53	9,050
C-10 to 324	2.76		14,225	C-10 to 335	3.53	8,715
C-10 to 325	2.03		16,370	C-10 to 336	3.53	10,170



Station location diagram

Table 24

Results of Soniscope Tests

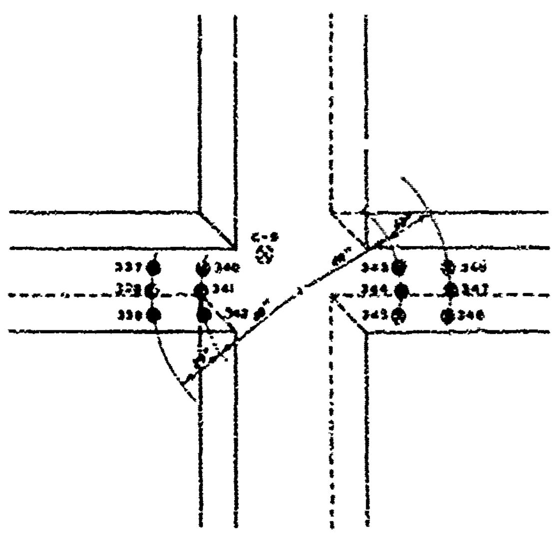
3d Floor Spandrel Beam at Column 8

Readings Through Beams, Columns, and Column-Beam Connections

(South Side)

(Not Grouted)

Station Numbers	Path Length ft	Velocities fps Straight Through	Diagonal
C-8	1.17	15,195	
C-8 to 337	5.13		10,020
C-8 to 338	5.13		13,035
C-8 to 339	5.13		11,305
C-8 to 340	3.53		13,320
C-8 to 341	3.53		12,430
C-8 to 342	3.53		10,895
C-8 to 343	3.53		14,350
C-8 to 344	3.53		14,350
C-8 to 345	3.53		14,350
C-8 to 346	5.13		14,210
C-8 to 347	5.13		13,902
C-8 to 348	5.13		14,100



Station location diagram

Table 25

<u>Results of Soniscope Tests</u>

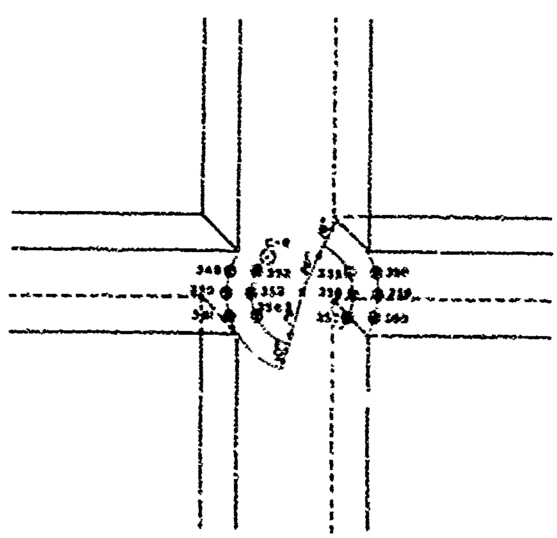
3d Floor Spandrel Beam at Column 6

Readings Through Beams, Columns, and Column-Beam Connections

(South Side)

(Grouted)

Station Numbers	Path Length ft	Velocities fps: Straight Through	Velocities fps: Diagonals
C-6	1.17	14,810	
C-6 to 349	2.76		12,105
C-6 to 350	2.76		13,940
C-6 to 351	2.76		[illegible]
C-6 to 352	2.03		[illegible]
C-6 to 353	2.03		[illegible]
C-6 to 354	2.03		[illegible],500
C-6 to 355	2.03		12,455
C-6 to 356	2.03		14,400
C-6 to 357	2.03		13,270
C-6 to 358	2.76		13,205
C-6 to 359	2.76		13,205
C-6 to 360	2.76		12,050



Station location diagram

Table 26

Results of Soniscope Tests

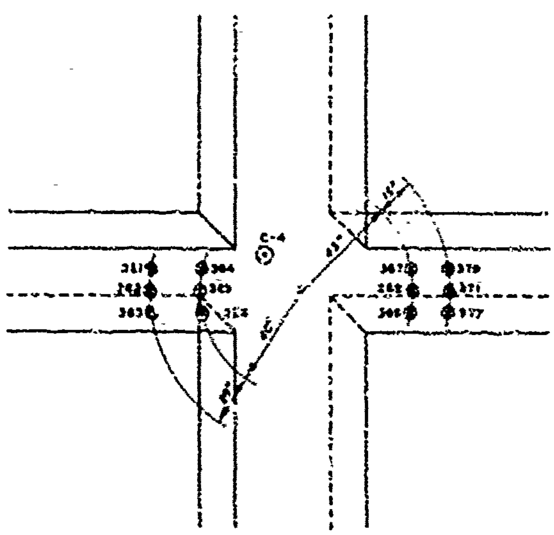
3d Floor Spandrel Beam at Column 4

Readings Through Beams, Columns, and Column-Beam Connections

(South Side)

(Grouted)

Station Numbers	Path Length ft	Velocities fps	
		Straight Through	Diagonals
C-4	1.17	14,445	
C-4 to 361	5.13		9,625
C-4 to 362	5.13		10,200
C-4 to 363	5.13		9,450
C-4 to 364	3.53		12,930
C-4 to 365	3.53		10,600
C-4 to 366	3.53		12,255
C-4 to 367	3.93		11,360
C-4 to 368	3.93		12,360
C-4 to 369	3.93		11,800
C-4 to 370	5.13		8,170
C-4 to 371	5.13		11,450
C-4 to 372	5.13		9,810



Station location diagram

Table 27

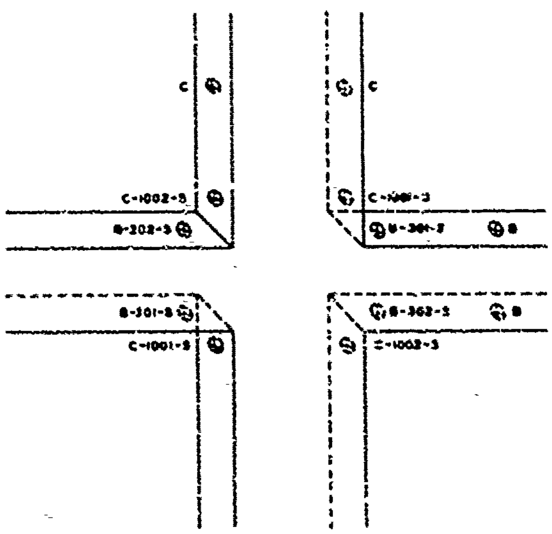
Results of Soniscope Tests

3d Floor Spandrel Beam at Column 10

Column-Beam Readings Through Outer 6 in.

South Side of Building

Station Numbers	Path Length ft	Velocities fps Straight Through	Velocities fps Diagonals
B-301-S	3.7		13,355
B-302-S	3.7		13,755
C-1001-S	3.8		13,620
C-1002-S	3.75		13,890
C	1.7	15,180	
B	2.6	14,130	



Station location diagram

Table 28

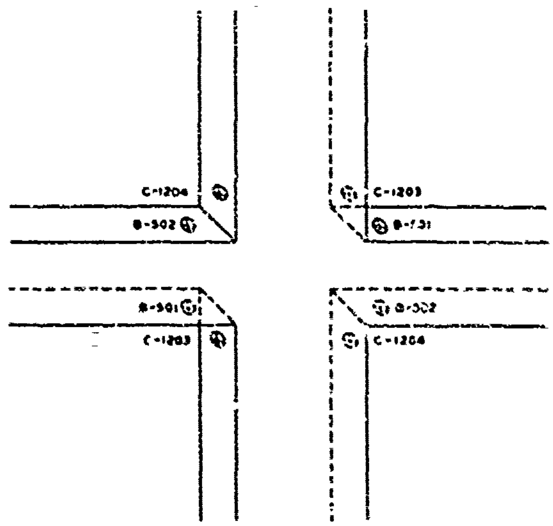
<u>Results of Soniscope Tests</u>

5th Floor Spandrel Beam at Column 12

Column-Beam Readings Through Outer 6 in.

North Side of Building

Station Numbers	Path Length ft	Diagonal Velocities fps
B-501	5.6	12,785
B-502	5.7	10,775
C-1203	5.4	14,675
C-1204	5.3	14,135



Station location diagram

Table 29

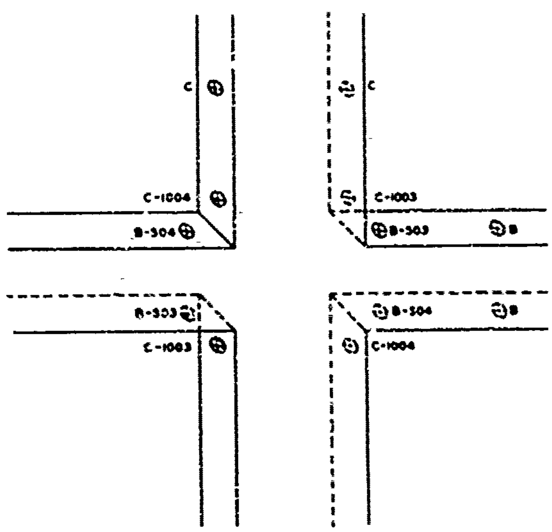
Results of Soniscope Tests

5th Floor Spandrel Beam at Column 10

Column-Beam Readings Through Outer 6 in.

North Side of Building

Station Numbers	Path Length ft	Velocities fps	
		Straight Through	Diagonals
B-503	3.3		14,165
B-504	3.6		14,285
C-1003	3.6		15,126
C-1004	3.9		14,285
C	4.3	15,560	
B	2.6	15,030	



Station location diagram

Table 30

Results of Soniscope Tests

East Stairway, Wall 2 Between Wall T and Fan Room Wall

First Floor

(Not Grouted)

Station Numbers	Station References: Distance from Fan Room Wall in.	Station References: Distance up from Floor in.	Path Length ft	Velocities fps: Straight Through	Velocities fps: Diagonals	Remarks
SW-101	14	136	1.00	15,875		
SW-102	42	136				Only one side accessible
SW-103	82	136				Only one side accessible
SW-104	122	136				Only one side accessible
SW-105	162	136				Only one side accessible
SW-106	192	136				Only one side accessible
SW-107	162	84				Only one side accessible
SW-108	120	84				Only one side accessible
SW-109	62	84				Only one side accessible
102 to 109			4.42		8,110	
103 to 109			4.35		8,880	
103 to 108			4.81		7,990	
104 to 108			3.98		13,050	
104 to 107			4.99		9,325	
106 to 107			4.31		8,850	

Table 31

Results of Soniscope Tests

East Stairway, Wall 2 Between Wall T and Fan Room Wall

Second Floor

(Not Grouted)

Station Numbers	Station References: Distance from Fan Room Wall in.	Station References: Distance up from Floor in.	Path Length ft	Velocities fps: Straight Through	Velocities fps: Diagonals	Remarks
SW-201	14	139	1.00	14,705		
SW-202	42	139	1.00	15,875		
SW-203	82	139	1.00	15,875		
SW-204	122	139				Only one side accessible
SW-205	162	139				Only one side accessible
SW-206	192	139				Only one side accessible
SW-207	177	102				Only one side accessible
SW-208	122	88				Only one side accessible
SW-209	66	72				Only one side accessible
201 to 202			2.52		11,405	
202 to 209			5.77		8,730	
203 to 209			5.38		10,530	
203 to 208			5.25		10,690	
205 to 208			5.20		10,505	
204 to 207			5.45		14,440	
206 to 207			3.54		13,615	

Table 32

Results of Soniscope Tests

East Stairway, Wall 2 Between Wall T and Fan Room Wall

Third Floor

(Not Grouted)

Station Numbers	Station References: Distance from Fan Room Wall in.	Station References: Distance up from Floor in.	Path Length ft	Velocities fps: Straight Through	Velocities fps: Diagonals	Remarks
SW-301	28	120	1.00	15,875		
SW-302	68	120				Only one side accessible
SW-303	108	120				Only one side accessible
SW-304	148	120				Only one side accessible
SW-305	188	120				Only one side accessible
SW-306	158	85				Only one side accessible
SW-307	108	60				Only one side accessible
SW-308	68	70				Only one side accessible
301 to 302			3.48		9,945	
301 to 308			5.62		4,030	
303 to 308			5.30		13,185	
302 to 307			5.92		11,065	
304 to 307			6.17		12,390	
303 to 306			5.23		12,395	
305 to 306			3.81		13,705	

Table 33

Results of Soniscope Tests

East Stairway, Wall 2 Between Wall T and Fan Room Wall

Fourth Floor

(Not Grouted)

	Station References			Velocities fps		
Station Numbers	Distance from Fan Room Wall in.	Distance up from Floor in.	Path Length ft	Straight Through	Diagonals	Remarks
SW-401	14	125	1.00	14,925		
SW-402	41	125	1.00	15,625		
SW-403	81	125				Only one side accessible
SW-404	121	125				Only one side accessible
SW-405	161	125				Only one side accessible
SW-406	211	125				Only one side accessible
SW-407	161	95				Only one side accessible
SW-408	121	71				Only one side accessible
SW-409	70	65				Only one side accessible
401 to 402			2.62		10,040	
402 to 409			5.51		6,090	
403 to 409			5.08		12,180	
403 to 408			5.65		12,470	
404 to 408			4.83		12,675	
404 to 407			3.98		12,715	
406 to 407			4.04		12,705	
405 to 408			6.06		12,120	

Table 54

Results of Sonisc[illegible] Tests

Mechanical Equipment Room B-[illegible]54A, Wall 13

	Station References			Velocities, fps		
Station Numbers	Distance from North Face Wall D, in.	Distance Up from Concrete Threshold, in.	Path Length, ft	Straight Through	Diagonal	Remarks
101	59	[illegible]	0.67	[illegible]		
102	59	115				Only one side accessible
103	[illegible]	[illegible]				Only one side accessible
104	141	[illegible]				Only one side accessible
105	109	[illegible]				Only one side accessible
106	25	54	0.67	14,500		
107	[illegible]	[illegible]				Only one side accessible
108	4	[illegible]				Only one side accessible
109	4	73				Only one side accessible
110	4	35				Only one side accessible
111	4	43				Only one side accessible
112	46	[illegible]				Only one side accessible
113	38	[illegible]				Only one side accessible
114	50	[illegible]	0.67	15,510		
115	65	97	0.67	[illegible]		
116	15	[illegible]				Only one side accessible
117	55	133				Only one side accessible
118	73	150				Only one side accessible
119	71	152				Only one side accessible
	Distance Up from South Corner of Door	Distance South				
128	10	[illegible]	0.67	15,100		
129	10	[illegible]	0.67	[illegible]		
130	32	[illegible]				Only one side accessible
131	60	[illegible]				Only one side accessible
132	[illegible]	155				Only one side accessible
133	6	[illegible]				Only one side accessible
134	52	[illegible]				Only one side accessible
135	[illegible]	[illegible]				Only one side accessible
[illegible]	[illegible]	[illegible]				Only one side accessible
[illegible]	[illegible]	[illegible]				Only one side accessible
101 to 102			[illegible]		[illegible]	
101 to 103			[illegible]		[illegible]	
101 to 104			[illegible]		[illegible]	
101 to 105			[illegible]		[illegible]	
[illegible]			[illegible]		[illegible]	
[illegible]			[illegible]		[illegible]	
[illegible]			[illegible]		[illegible]	
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[illegible]			[illegible]		[illegible]	
[illegible]			[illegible]		[illegible]	
[illegible]			[illegible]		[illegible]	

Table 35

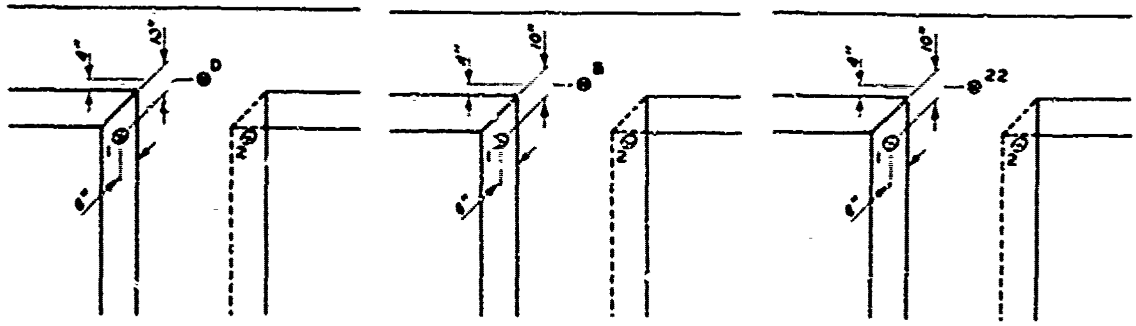
Results of Soniscope Tests

Readings on Column-Beam Connections

Around Outpatient Clinic

(Grouted)

Station Numbers	Path Length ft	Diagonal Velocities fps
D to 1	1.18	14,935
D to 2	1.18	15,130
B to 1	1.18	12,555
B to 2	1.18	12,555
Col 22 to 1	1.18	15,325
Col 22 to 2	1.18	15,325
Column A	2.36	11,455
Column 29	2.36	14,305

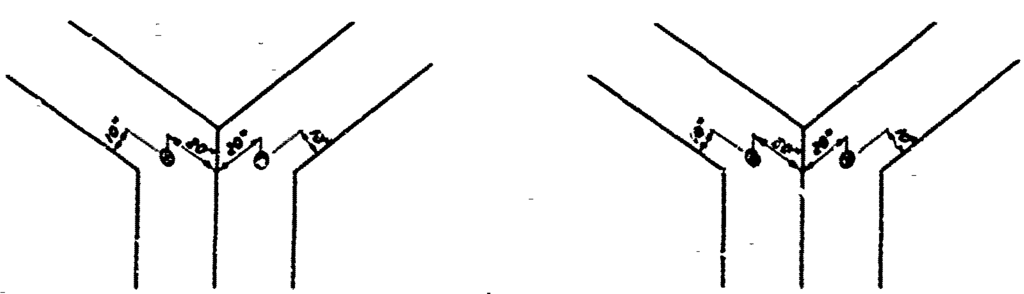


(1) Column D on wall 9

(2) Column B on wall 9

(3) Column 22 on wall A

A. Column-beam connections (grouted)



(1) Column A

(2) Column 29

B. Corner columns (grouted)

Table 36

Velocity Tests of Epoxy-Repaired Cores

Test Condition	Velocities, fps		
	Film	1/16-in. Layer	1/8-in. Layer
Saturated, before breaking	14,645	14,540	14,645
After 24 hr curing at 70 to 80 F	14,410	14,060	14,000
After 24 hr curing at 150 F	13,575	13,520	13,730
After 43 hr curing at 120 F	13,710	13,650	13,730
Saturated, final reading	13,575	14,060	13,730